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(54) **Titre : METHODE DE LUTTE CONTRE LES POUX DE MER**
(54) **Title: METHOD OF COMBATING SEA LICE**

(57) **Abrégé/Abstract:**
The invention provides a method of treatment of farmed fish to combat infestation by multicellular ectoparasites with exoskeletons, which method comprises topically exposing farmed fish, especially salmon in sea cages, to a first and a second sea lice treatment agent, said first sea lice treatment agent being a carbamate or organophosphate and said second sea lice treatment agent being a pyrethroid or pyrethrin.

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(54) Title: METHOD OF COMBATING SEA LICE

(57) Abstract: The invention provides a method of treatment of farmed fish to combat infestation by multicellular ectoparasites with exoskeletons, which method comprises topically exposing farmed fish, especially salmon in sea cages, to a first and a second sea lice treatment agent, said first sea lice treatment agent being a carbamate or organophosphate and said second sea lice treatment agent being a pyrethroid or pyrethrin.

METHOD OF COMBATING SEA LICE

FIELD OF THE INVENTION

This invention relates to a method of topical treatment of living fish to combat multicellular ectoparasites with exoskeletons, especially ectoparasites of the crustacean order copepod, more particularly of the genera *Lepeophtheirus* (especially the salmon louse, *Lepeoptheirus salmonis*) and *Caligus* (especially *Caligus elongates*), to materials and to a treatment kit for use in that method.

BACKGROUND

Strange though it may seem, in aquaculture there is a major problem with the infestation of the cultured fish, for example salmon, with sea lice. Generally, the fish are treated with organophosphates, for example azamethiphos or dichlorvos, or pyrethroids, for example deltamethrin or cypermethrin which are known chemical sea lice treatments.

Chemical sea lice treatments which are currently available generally fall into three classes: organophosphates (e.g. malathion), carbamates (e.g. carbaryl), and pyrethroids (e.g. permethrin).

These sea lice treatment chemicals however have toxic effects. Concerns have long been expressed about organophosphate toxicity in particular, for example in relation to farm workers. Organophosphate poisoning does not require ingestion - cutaneous absorption can lead to signs of poisoning. Symptoms of organophosphate poisoning may include excessive excessive salivation, sweating, rhinorrhea, muscle twitching, weakness, tremor, incoordination, headache, dizziness, nausea,

vomiting, abdominal cramps, diarrhoea, respiratory depression, wheezing, blurred vision and more. Carbamates can cause adverse reactions such as sweating, vision blurring, incoordination and convulsions. Pyrethroids similarly can cause adverse reactions even on dermal exposure, such as excitory neurotoxicity, altered dopamine uptake, and dermatitis.

This is of particular concern not only in relation to the health of workers in the aquaculture industry and, obviously the health of the cultured fish, but also in relation to the release into the environment which almost inevitably occurs when non-juvenile fish, which are generally held in cages rather than tanks, are treated. We have found however that exposure to these chemical agents may be reduced by application of an organophosphate or carbamate and of a pyrethroid, optionally simultaneously, but preferably staggered and particularly preferably staggered in that order. Thus, the administration according to the invention is more concerned with reducing exposure to potentially toxic chemicals than with overcoming ectoparasite resistance to sea lice treatments.

SUMMARY OF EMBODIMENTS OF THE INVENTION

Thus viewed from one aspect the invention provides a method of treatment of farmed fish to combat infestation by multicellular ectoparasites with exoskeletons, in particular sea lice, which method comprises topically exposing farmed fish, especially fish in cages, to a first and a second sea lice treatment agent, said first sea lice treatment agent being a carbamate or organophosphate and said second sea lice treatment agent being a pyrethroid or pyrethrin.

Viewed from another aspect the invention provides the use of a pyrethroid or pyrethrin for the treatment of sea lice that reside on farmed fish up to 12 hours after said sea lice have previously been exposed to an

organophosphate or carbamate.

Viewed from another aspect the invention provides the use of an organophosphate or carbamate for the preparation of a first topical sea lice treatment agent composition and of a pyrethroid or pyrethrin for the preparation of a second topical sea lice treatment agent composition to be administered topically to farmed fish in the order of the first topical sea lice treatment agent composition followed by the second topical sea lice treatment agent composition up to 12 hours after the first topical sea lice treatment agent composition is administered, for treating infestation by multicellular ectoparasites with exoskeletons.

Viewed from a further aspect the invention provides a kit for the topical treatment of sea lice infestations in farmed fish comprising in separate containers a first topical sea lice treatment agent composition containing a carbamate or organophosphate and a second topical sea lice treatment agent composition containing a pyrethroid or pyrethrin, and an instruction that the second topical sea lice treatment agent composition is to be administered up to 12 hours after the first topical sea lice treatment agent composition is administered.

DETAILED DESCRIPTION

The farmed fish treated according to the invention may be any fish susceptible of ectoparasite infestation. The fish however is especially preferably carp, tilapia, cod, halibut, or, most preferably a salmonid, such as trout or salmon, especially salmon.

Treatment of the farmed fish is topical in that the fish are introduced into an aqueous environment containing the sea lice treatment agent or caused to transit such an environment, or have the sea lice treatment agent introduced into the aqueous environment containing the fish. Thus for example, fish may be

transferred into a tank for treatment or caused to pass from one holding zone, e.g. a tank or cage, into another through a conduit, e.g. a pipe or channel, containing

the sea lice treatment agent. Alternatively, the sea lice treatment agent may be released into the cage, tank or pond containing the fish, optionally after surrounding the cage with an impervious barrier, e.g. a tarpaulin, to cause at least temporary retention of the sea lice treatment agent within the water in the cage. Particularly preferably, the sea lice treatment agent is released into the water within a cage, e.g. a sea cage, over an extended period so as to ensure exposure of the fish to the sea lice treatment agent before the agent is flushed out of the cage by the flow of surrounding water. Where the agent is to be released into a sea-cage, the sea-cage net will typically be raised to a depth of 2-2.5 metres and then surrounded by impervious tarpaulins to isolate the cage to be treated. Typically, the depth of enclosed water may be about 3 metres such that there will be some space (e.g. about 0.5-1 m) between the net bottom and the tarpaulin. The sea lice treatment agents may then be added to the prepared sea-cage at several locations to ensure maximum dispersion. Sequential treatment may be effected by sequential addition of different sea lice treatment agents or by sequential transfer through conduits or between tanks as discussed above.

The exposure to the sea lice treatment agents is desirably for a period of 10 to 100 minutes per agent, especially 15 to 60 minutes, especially about 20 to 40 minutes. Where treatment is sequential, it is desirably staggered by an intervening period of 10 minutes to 12 hours, especially at least 15 minutes, e.g. 15 minutes to 4 hours, more preferably 30 minutes to 3 hours, especially about 2 hours.

Particularly preferably, the fish are also treated (preferably pre-treated) with a monooxygenase inhibitor as a synergist for the pyrethroid/pyrethrin, e.g. piperonyl butoxide. This may be presented with the pyrethroid/pyrethrin treatment (e.g. in a mixture with the pyrethroid/pyrethrin), or prior to the

pyrethroid/pyrethrin treatment. For example, this may be administered with the fish food, e.g. 12 hours to 60 hours, especially 24 to 48 hours, before exposure to the pyrethroid/pyrethrin.

The two sea lice treatment agent compositions may take any convenient topical application form, e.g. solution, dispersion, powder, etc. Since they will be diluted within the water in which the fish are present, their concentrations and formulations are not critical. Commercially available compositions may be used.

In an especially preferred embodiment, the first-applied composition is an organophosphate-containing solution, or a physiologically tolerable carbamate formulation, and the later applied composition is a pyrethroid-containing composition.

The organophosphate used according to the invention may be any organophosphate with ectoparasite killing effect (preferably with sea lice killing effect) which is physiologically tolerable on dermal application. Examples of such compounds include malathion, parathion, dichlorvos, azamethiphos, chlorpyrifos, chlorthion, trichlorphon, methyl parathion, and fenchlorphos. The use of azamethiphos or dichlorvos however is preferred. Where a carbamate is used, this may be any carbamate with ectoparasite killing effect (preferably with sea lice killing effect) which is physiologically tolerable on dermal application. One example of such a compound is carbaryl. The use of an organophosphate however is preferred.

For treatment of sea lice in particular, the organophosphate or carbamate is preferably present in the water to which the fish are exposed at a concentration of 5 to 1,000 ppb by wt., especially 10 to 500 ppb, particularly 20 to 300 ppb. For azamethiphos, the preferred concentration is 40 ppb, while for dichlorvos it is 200 ppb.

The pyrethroid or pyrethrin used according to the invention may be any pyrethroid or pyrethrin with

ectoparasite killing effect (preferably with sea lice killing effect) which is physiologically tolerable on dermal application. Examples of such pyrethroid compounds, which are generally preferred relative to the pyrethrins, include permethrin, phenothrin, cypermethrin, pyrethrin and deltamethrin. The use of deltamethrin or cypermethrin however is preferred. The pyrethrins, if used, may for example be derived from natural sources such as the chrysanthemum plant. However, where pyrethrins are used, it is preferred also to use a synergist (as discussed above).

For treatment of sea lice in particular, the pyrethroid or pyrethrin is preferably present in the water to which the fish is exposed at a concentration of 0.5 to 50 ppb wt., especially 1 to 25 ppb, particularly 2 to 20 ppb. The preferred concentration for deltamethrin is 1 to 2 ppb, while that for cypermethrin is 5 to 10 ppb.

For treatment of other ectoparasites, the sea lice treatment agent concentrations may be adjusted appropriately.

The method of the invention may if necessary be repeated, e.g. after 7 to 10 days, but for a single case of infestation a single performance of the method will generally be sufficient.

One or both of the sea lice treatment agent compositions may advantageously contain a further sea lice treatment agent, e.g. selected from the chloronicotinyl (e.g. imidacloprid), phenylpyrazole (e.g. fipronil), oxadiazine (e.g. indoxacarb), pyrazole (eg chlorfenapyr), or organochlorine (e.g. lindane) classes.

While in the method of the invention it is most preferable to administer the pyrethroid/pyrethrin after the organophosphate/carbamate, administration in the reverse order can be beneficial and forms a further, though less preferred, aspect of the invention.

Claims:

1. A kit for the topical treatment of sea lice infestations in farmed fish comprising in separate containers a first topical sea lice treatment agent composition containing a carbamate or organophosphate and a second topical sea lice treatment agent composition containing a pyrethroid or pyrethrin, and an instruction that the second topical sea lice treatment agent composition is to be administered up to 12 hours after the first topical sea lice treatment agent composition is administered.

2. The use of an organophosphate or carbamate for the preparation of a first topical sea lice treatment agent composition and of a pyrethroid or pyrethrin for the preparation of a second topical sea lice treatment agent composition to be administered topically to farmed fish in the order of the first topical sea lice treatment agent composition followed by the second topical sea lice treatment agent composition up to 12 hours after the first topical sea lice treatment agent composition is administered, for treating infestation by multicellular ectoparasites with exoskeletons.

3. The use of a pyrethroid or pyrethrin for the treatment of sea lice that reside on farmed fish up to 12 hours after said sea lice have previously been exposed to an organophosphate or carbamate.

4. The kit of claim 1, wherein said farmed fish are salmonids.

5. The kit of claim 4, wherein said salmonids are salmon.

6. The kit of claim 1, wherein the farmed fish are in cages.

7. The kit of claim 1, wherein the first topical sea lice treatment agent is selected from azamethiphos and dichlorvos and the second topical sea lice treatment agent is selected from deltamethrin and cypermethrin.